The market value of UK dividends from shares with differing entitlements

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Abstract

This paper determines the market value of dividends in the UK during periods before and after 1997. Previous studies, which use the ex-dividend day method, tend to provide noisy and potentially biased measures of dividend value. We estimate the value of dividends from the prices of shares that are identical except for their dividend entitlements, and are traded concurrently (within the same hour). We argue that our estimates of dividend value are the cleanest yet available for the UK. Our evidence suggests that ex-dividend day estimates are biased downwards, but that this bias may be mitigated by the use of robust regression. Dividend values are heterogeneous and are not explained by the tax-clientele hypothesis.

Keywords: dividend value, personal taxes, market microstructure, ex-dividend day method

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1. INTRODUCTION

The standard method of estimating the market value of a dividend is to observe the fall in the share price on the relevant ex-dividend day. This fall can then be divided by the cash value of the dividend to arrive at the drop-off ratio or dividend-valuation ratio (DVR). Many, though not all, studies in the UK and USA report DVRs of less than one, but the interpretation of this finding has proved controversial.

Recently, two studies have sought to infer the market value of dividends from the prices of two classes of share in the same company which trade concurrently and which are identical except for their entitlement to the next cash dividend payment. We call this the concurrent trades method. Walker and Partington (1999) use the fact that some shares in Australia can be traded both ex-dividend and cum-dividend concurrently, whilst Chu and Partington (2002) infer dividend values from the prices of fully paid new shares following certain rights issues in Australia in which the new shares are not entitled to the next dividend. Chu and Partington report mean DVRs considerably in excess of one and infer that dividend values are being set by long term investors. Their evidence suggests that these investors are tax-advantaged institutions which particularly benefit from the imputation tax credits attached to the dividends. The dividend values reported by Chu and Partington are materially greater than the values derived from traditional ex-dividend day studies in Australia.

The present paper applies the concurrent trades method to a sample of UK rights issues in which the new shares are not entitled to the next dividend. The paper proceeds as follows. Section 2 discusses the ambiguities of interpretation of ex-dividend day evidence and reviews the findings of UK ex-day studies. These studies report DVRs of less than one, despite the facts that about half the listed shares are owned by institutions which paid little or no tax on dividends, and that pension funds could reclaim imputation tax credits before July 1997. Section 3 presents the concurrent trades method and argues that it should provide less noisy and, potentially, less biased estimates of the market value of dividends.

The results are presented in Section 4. We consider observations from before and after 1997, when the cash refund of imputation credits for pension funds was withdrawn. We provide results from samples using the concurrent trades method and from the same samples

using the traditional ex-dividend day method. As the concurrent trades samples are quite small, we also report ex-dividend results from separate, much larger, samples from before and after 1997.

The concurrent trades DVRs are considerably less noisy than the DVRs using the ex-dividend method. The sample-wide concurrent trades DVR is greater than one on most measures, which differs from the traditional ex-day results that we present and from previous ex-day estimates of DVRs in the UK. A sample DVR of greater than one suggests that many dividends are valued gross of personal tax, and suggests a more important role for tax-privileged institutions in the determination of market values than do ex-dividend day studies. As a result of our findings, we suggest that ex-day evidence may provide estimates of dividend value which are biased downwards, and that the bias is alleviated by the use of robust regression. There is little evidence of a change in the DVR after 1997, and we find no evidence of tax-clientele effects. Section 5 concludes the paper.

2. THE VALUE OF DIVIDENDS AFTER PERSONAL TAX

(i) Ex-dividend day studies

We begin by considering a risk-neutral world without taxes or transaction costs. In such a world, the market value of a dividend should be equal to the cash value. The mean drop in share price when a share goes ex-dividend, which is an estimate of the market value, should equal the cash value of the dividend paid on that share. There will be variation around the mean because the share price can change on the ex-day due to the arrival of new information, but the mean should be close to one in a large sample.

However, a considerable number of US empirical studies show that the DVR is consistently less than one. Elton and Gruber (1970) argue that this finding arises because dividends are taxed more heavily than capital gains. They argue that the DVR from ex-dividend day evidence, $(P_{cum} - P_{ex})/D$, is determined by

$$(P_{cum} - P_{ex})/D = (1 - T_I)/(1 - T_G) \quad (1)$$

where P_{cum} is the price at the close of the day before the ex-date, P_{ex} is the price at the close of the ex-date, D is the dividend per share before personal tax, T_I is the income tax rate of the

marginal investor in the relevant share, and T_G is the marginal investor's CGT rate. Empirically, Elton and Gruber find that the mean DVR is less than one and is positively related to dividend yield. This has been interpreted as evidence for the existence of tax clienteles in share ownership: high-yield shares, it is argued, tend to be held by investors paying relatively low rates of income tax, and vice versa for low-yield shares.

One problem with the above tax-based explanation for observed DVRs is that there are near-arbitrage opportunities for any investor with personal tax rates giving a ratio $(1 - T_I)/(1 - T_G)$ which is different from that obtained by substituting the dividend and observed price drop in equation (1). For example, if the fall in price is less than the value of the dividend, resulting in a DVR less than one, then a tax-exempt investor, or an investor equally taxed on dividends and capital gains, could expect to gain by buying the share the day before the ex-date, selling on the ex-date and receiving the dividend. Of course, the return would be net of transactions costs and a gain is not guaranteed since the ex-day price is not known in advance. Furthermore, the strategy potentially involves a temporary increase in the risk of the investor's portfolio because of sub-optimal diversification. But trading volumes in the USA around ex-dividend days are much larger than usual, which suggests that trading to exploit near-arbitrage opportunities does take place.

If, before transactions costs, the equilibrium DVR is one[1] for investors who are seeking to exploit arbitrage opportunities, then the observed DVR will be given by $(D - C)/D$, where C is the transactions costs of the requisite trades. Thus, a DVR of less than one could be driven by the transactions costs of short-term dividend-capture trading rather than by a tax disadvantage to dividends (see Allen and Michaely, 1995). Given that the absolute value of transactions costs is a positive function of share price, the impact of transactions costs on dividend values is less important for shares with high dividend yields than for shares with low dividend yields. Consequently, if arbitrageurs set prices about the ex-dividend date, transaction costs should result in DVRs which are positively related to dividend yields.

Some more recent papers examine market microstructure effects, and cast further

[1] An equilibrium DVR of one, before transactions costs, applies to tax-exempt investors and to investors who are equally taxed on dividends and capital gains.

doubt on the use of ex-dividend day DVRs as a clean measure of dividend value. Bali and Hite (1998) examine the effect of tick size. For share prices above $1, the tick size on the New York Stock Exchange was 12.5 cents until 1997 (the minimum tick size had been reduced to one cent by 2001). The minimum tick size of 12.5 cents meant that the share prices could not change by the exact amount of the dividend, unless the dividend was a multiple of the tick size. Bali and Hite's work suggests that the result was a downward bias in the DVR which became less severe as the size of the dividend increased. Hence a positive relation is predicted between DVR and the size of dividend. Since the size of the dividend and dividend yield are positively related, the tick effect also predicts a positive relation between the DVR and dividend yield. However Graham et al (2003) cast doubt on Bali and Hite's tick size effect. Graham et al examine the effect of decimalisation on ex-dividend price movements on the New York Stock Exchange and find that abnormal ex-dividend day returns increased with the introduction of decimalisation. This implies that DVRs decreased as the tick size was reduced. This is the direct opposite of the prediction from Bali and Hite's argument, which is that DVRs should have increased as tick sizes were reduced. The significance of the tick size effect is therefore debatable. In any event, it seems unlikely that the tick size effect will be important in the UK market, since tick sizes in the UK are small.

Frank and Jagannathan (1998) find that the DVR in Hong Kong was significantly less than one despite an absence of taxes on dividends and capital gains. They suggest that bid-ask bounce and transactions costs explain their result. In their model, investor aversion to the cost of handling dividends leads to selling pressure cum-dividend and buying pressure ex-dividend, so cum-dividend trades are more likely to be at the bid and ex-dividend trades are more likely to be at the ask, thus narrowing the observed ex-day price drop. They argue that this effect will be stronger for smaller dividends, which have higher handling costs per dollar of dividend. This potential arbitrage opportunity in Hong Kong disappeared after the introduction of electronic settlement, which reduced the holding period for an ex-dividend arbitrage from twenty-one days to less than one day. Kadapakkam (2000) shows that after the introduction of electronic settlement in Hong Kong in 1993, the DVR was not significantly different from one. So it appears that long holding periods inhibit ex-day arbitrage.

Lasfer (1995) also provides evidence that settlement arrangements can potentially affect DVRs. Before 18 July 1994, the London Stock Exchange operated a fixed settlement-date system in which the year was divided into account-settlement periods of either two or three weeks. Under this system, investors could hold shares for at least two weeks prior to payment on settlement day, and several authors have identified positive abnormal returns on the first day of the account, which may reflect this financing advantage. A large majority of shares went ex-dividend on the first day of the account period, and in these cases, an investor purchasing a share on the cum-dividend day could be required to settle the transaction at least two weeks earlier than if he purchased on the ex-dividend day. Adjustment for the time value of the difference in settlement dates reduces the ex-day price in relation to the last cum-dividend price, and hence shifts a DVR below one nearer to one.

In summary, the tax-clientele view predicts (i) that the DVRs should be less than one on average and (ii) that DVR and dividend yield should be positively related. However, the same results could arise if prices are set by dividend-capture traders subject to transaction costs. There are three other possible explanations for DVRs of less than one based on transactions costs and market microstructure, namely the tick effect, bid-ask spread effect, and the effect of the settlement period. Of these the tick and bid-ask spread effects predict a positive relation between DVR and yield, assuming that dividend size and yield are positively related.

(ii) An equilibrium with heterogeneous marginal traders

A framework for analysing the market value of dividends, in a similar setting to our study, has recently been presented by Chu and Partington (2002). Their analysis is akin to that of Boyd and Jagannathan (1994). It assumes a context in which it is possible to trade, over an extended period, two classes of share in the same company which are identical except in their entitlement to the next dividend. The analysis distinguishes between traders who are acting as *investors* and traders who are acting as *arbitrageurs*. An investor is someone who has decided to trade the share for reasons unconnected with the next dividend. The decision he or she faces is then whether to trade the share entitled to the dividend, or to trade the unentitled share. The

investor makes the decision by comparing his or her personal after-tax value of the dividend with the market value of the dividend, measured by the difference between the prices of the two classes of share. Transactions costs are not a significant consideration for an investor since they will be incurred irrespective of whether the investor chooses to trade in the share entitled to the dividend, or the unentitled share.[2] Let us ignore capital gains tax for the moment. Suppose, for example, that the market value of the dividend on share *i* is the same as the cash value, but that an investor wishing to buy the share would pay some income tax on *i*'s dividend. Then the investor will choose to buy the unentitled class of share *i*, because the price of the entitled share incorporates a value for the dividend which exceeds its after-tax value to this particular investor.

Arbitrageurs, or short-term traders, are agents who trade concurrently in the two classes of the share to exploit a difference between the market value of a dividend and its value to the arbitrageur. The value of a dividend to an arbitrageur is determined not only by the arbitrageur's tax position, but also by the transactions costs of conducting the arbitrage, which include the bid-ask spread. The transactions cost disadvantage means that arbitrageurs will only be able to compete in the market if they have a tax advantage over the marginal investors.

In this analysis, the market value of the dividend on share *i* is its after-tax value to the marginal buyer or seller. Chu and Partington (2002) argue that tax-advantaged pension funds acting as *investors* are likely to be the marginal, price-setting traders. They will attach a higher value to dividends than will arbitrageurs, for whom transactions costs are relevant. If this is the case, the DVR is invariant with respect to the dividend yield. Transactions costs do not affect dividend value, and since the marginal trader represents only one class of investor, there is no clientele effect. Consequently, no relationship is expected between the DVR and dividend yield. However, Chu and Partington acknowledge that pension funds might not be trading at the margin in all stocks at all times. Therefore, it is possible that investors across

[2] A small effect arises if transactions costs are assumed to be proportional to price, since the price of the unentitled share will be lower than the price of the entitled share. If transactions costs are modelled as a fixed cost they drop out of the equilibrium pricing conditions.

different shares and different trading times might not all be in the same tax bracket. In this case DVRs could differ across shares in an unsystematic fashion. But there is no reason to expect a systematic relation between DVR and dividend yield. The key difference between the above analysis and the tax-clientele view is the prediction that a pension fund is likely to be the price-setting trader for any share. Whereas in the tax-clientele view, the tax-advantaged investors such as pension funds set the prices for high yield shares.

If capital gains tax (CGT) is introduced, the after-tax value of a dividend to both buyer and seller rises. This is because the CGT benefit from the ex-dividend price drop reduces the after-tax cost of receiving the dividend, ie the price drop. Under a classical tax system, the DVR allowing for CGT is $D(1 - T_I)/(1 - T_G)$, as in equation (1) (this ignores the second-order effect of any difference between the dates on which income tax and CGT are paid). Chu and Partington show that, with CGT, the after-tax value of a dividend can differ according to whether the investor is a buyer or a seller of the share. But the difference will not be large, and there is still no relation predicted between the DVR and dividend yield.

There are two main inferences from the above analysis. First, DVRs may vary across dividends depending on the tax position of the marginal trader, and on whether he or she is trading as an investor or as an arbitrageur. Second, if tax-advantaged long term investors determine dividend values, as expected, there will be no systematic relation between DVR and the size of the dividend or the dividend yield. But if arbitrageurs determine dividend values there will be a positive relation between the DVR and dividend yield driven by the transactions costs of arbitrage.

(iii) UK taxes and evidence on dividend value

Under the version of the imputation system which prevailed in the UK during 1973-97, companies paid dividends to shareholders net of advance corporation tax (ACT) which they paid direct to the Inland Revenue. Thus the relationship between the gross and net dividend is defined as $D_{net} = D_{gross}(1 - T_{ACT})$, where T_{ACT} is the ACT rate. In UK studies, the cash value of the dividend is regarded as the *net* dividend, after ACT has been paid. The ACT rate varied in a range between a high of 35% in 1976 and a low of 20% during 1993-97; for most of the

period it was equal to the basic rate of income tax. ACT counted both as part of the corporation tax on the profit paid out as dividend, and as all or part of the income tax on the dividend.

A shareholder paying income tax at the basic rate was not liable to any tax on the net dividend he received. A shareholder paying income tax at a higher rate was liable to additional income tax, at a rate on the net dividend such that the ACT plus the additional tax was equal to a payment at the higher rate of income tax on the gross dividend. A tax-exempt shareholder could reclaim from the Inland Revenue all of the ACT paid by the company.

The statutory rate of tax on capital gains was 30% up to 1988, when the statutory rates of income tax and CGT were equalised. But various provisions meant that the effective rate on capital gains was zero or much lower than the statutory rates for many investors. Tax-exempt shareholders paid no CGT. Because they paid no tax on the net dividend and could also recover the ACT, there was a clear tax advantage to dividends for tax-exempt shareholders. But in July 1997, the provision whereby pension funds could reclaim ACT was discontinued. The rate of ACT was cut from 20% to 10% in 1999 and the credit was discontinued altogether in 2004.

During the 1980s and 1990s about one-third of listed equity was owned by pension funds and charities, which were entirely exempt from tax on their investments. A further 15% was owned by life assurance funds which were not exempt but which in practice paid little personal tax, and could reclaim ACT. This arose because, in calculating their taxable income on investment, life assurance funds could offset their operating expenses against the income (see MacLeod and Levitt, 1999, for detail on the taxation of life offices). Ownership of UK shares by foreign institutions was growing and had reached 17% by 1995. Foreign institutions either received dividends net and paid no further UK tax, or were allowed a partial refund of ACT, depending on the relevant double-taxation treaty. For a more detailed discussion of the taxation of share returns in the UK and of share ownership by category of investor, see Armitage (2004) or Bell and Jenkinson (2002).

Table 1 shows the after-tax value of dividends by category of investor during 1988-93, the main period analysed in this paper. It can be seen that, if CGT is ignored, the only category

of investor which valued a dividend at less than the net dividend (ie, DVR < 1) was individuals paying income tax at the highest rate of 40%. If it is assumed that investors paid CGT at the maximum relevant rate, then all categories except foreign investors had a DVR of at least 1.33.

Table 1 around here

As might be expected from the discussion in Section 2(i), the evidence on dividend values after tax from existing UK ex-dividend studies is inconclusive, and indeed puzzling. Menyah (1993) reports mean DVRs for the 1960s and 70s which are below 0.5. Bell and Jenkinson (2002), Asimakopoulos and Hodgkinson (2001), Lasfer (1995, 1996), Crossland et al (1991) and Davidson and Mallin (1989) use data from the 1980s and 1990s. They find that, on average, the fall in price on the ex-day remains considerably smaller than the face value of net dividends; the mean full-sample DVRs reported range between 0.5 to 0.9 (if the face value of the dividend is viewed as the gross value, before subtracting ACT, the mean DVRs are in the region of 0.4 to 0.7). Lasfer's (1995) adjustment for the time value of different settlement dates increases the mean DVR by about 0.25, but his adjusted means are still slightly less than one. Menyah argues that no adjustment should be made, since settlement of trades in the last two days of an account period could be deferred to the end of the next period. Hodgkinson and Asimakopoulos incorporate adjustments both for settlement dates and for the bid-ask spread effect, but again their adjusted mean DVR is just below one. Thus, it might appear that the market value of dividends is, if anything, less than the cash value net of personal tax at the ACT rate, despite the fact that about half of listed shares were owned by institutions (pension funds, life funds and charities) which paid little or no tax and could reclaim some or all of the ACT.

In some cases the null hypothesis that the DVR was equal to one could not be rejected. However as Davidson and Mallin observe there are severe problems of noise and outliers in ex-dividend data. One consequence of this is likely to be low power statistical tests which make it difficult to reject the null hypothesis. Another consequence of these problems is that

they make results sensitive to filtering of the sample and the estimation method used. In order to deal with the effect of outliers, Davidson and Mallin suggest that robust regression methods be used. They find that this results in higher DVR estimates, some in excess of one.

Menyah (1993) and Lasfer (1995, 1996) find no evidence of arbitrageur trading around ex-dividend days from trading volumes, or from abnormal returns, in the few days before and after ex-days. They suggest that provisions introduced in 1970 to reduce tax avoidance may have prevented investors and security dealers from taking full advantage of the apparent near-arbitrage. For example, if a tax-exempt investor attempted dividend-capture trading, he or she could have become liable to tax. He would not have been able to claim all the tax credit on the dividend, $D_{net}[T_{ACT}/(1 - T_{ACT})]$, but only $N/30$ of the credit, where N is the number of days for which the share is held. However, it is not certain how effectively the anti-avoidance provisions were applied.

Menyah's (1993) and Lasfer's (1995, 1996) evidence is not only inconsistent with arbitrage trading, it is also inconsistent with the view that tax clienteles value dividends net of personal tax. Menyah finds no relation between DVR and dividend yield in the 1960s or 70s. Lasfer examines the ex-day abnormal return, which includes the cash value of the dividend. For the periods 1980-83 and 1985-93, he reports a positive relation between ex-day abnormal return and yield, which implies a *negative* relation between DVR and yield. Bell and Jenkinson (2002), on the other hand, present weak evidence of a positive relation between DVR and yield during 1995-99. It is not clear why the results from these papers differ, but a finding of no relation, or a negative relation, between DVR and yield is not consistent with the tax-clientele view and is difficult to square with the inference that dividends are valued net of personal tax.

The evidence from studies of changes in tax policy is also ambiguous, although it does suggest that 'tax matters'. There have been five major changes in the taxation of equity in the last 50 years, in 1952, 1958, 1965, 1973 and 1997, and many minor changes. Poterba and Summers (1985) examine dividend policy before and after the first four of the major changes, and generally find that they affected dividend values and pay-out policy. For example, the re-introduction of an imputation system in 1973 substantially increased the after-tax value of

dividends for all categories of investors, but did not affect CGT. Even tax-exempt investors benefited, because they could start to reclaim ACT. These authors find that DVRs rose after 1973, and that dividend pay-out ratios rose, which can be interpreted as a response by companies to the increased after-tax value of dividends in relation to capital gains.

In 1988, rates of income tax above 40%, paid by individuals, were abolished, and the statutory rates of income tax and CGT were equalised. As a consequence, the highest rate of personal tax on dividends became equal to the CGT rate, and dividends became more attractive to individuals who had been paying tax at rates above 40%. Lasfer (1995) finds that DVRs increased marginally after 1988 and attributes this to the change in taxes affecting individual investors. He argues that high-taxpaying individuals affected the market value of dividends, which supports the view that the anti-avoidance provisions were effective. In contrast, Bell and Jenkinson (2002) argue that pension funds affected the market value of dividends for the highest-yielding shares. They find that the mean DVR fell significantly after July 1997 for the highest-yielding quintile of shares, from 1.14 to 0.95. Since the 1997 change only affected pension funds, they infer that trading by pension funds affects the prices of high-yielding shares around ex-dividend dates. However, they also report a significant fall in the mean DVR for the middle quintile of shares by yield, from 0.93 to 0.72. If this fall is explained by price-setting by pension funds, why is the pre-97 DVR not substantially greater than one?

To summarise the UK ex-dividend day evidence, from the 1960s onwards, sample means of DVRs have consistently been found to be below one. If this finding is ascribed to the effect of personal tax, it implies that dividends have been valued net of personal tax at the ACT rate *and* net of some additional higher rate income tax; that effective CGT rates have been small; and that most dividend values have been set by investors paying income tax. The latter inference seems strange for recent decades, in which share ownership and trading has been dominated by institutional investors which either received dividends net of ACT, or could reclaim some or all of the ACT. Furthermore, there is no clear relation between DVR and dividend yield, and DVRs were apparently affected by the change in 1997, which only affected tax-exempt pension funds. These latter findings are difficult to explain if dividend

values are set by taxpaying investors.

It is apparent from the above review that the evidence on DVRs from UK ex-dividend studies is hard to interpret. We now explain the concurrent trades method of estimating dividend value, and why we expect it to provide more precise estimates than traditional ex-dividend studies.

3. DATA AND METHOD

(i) Concurrent trades method

The concurrent trades method provides explicit estimates of dividend values after tax. It exploits the fact that, during and after some rights issues, two classes of share in the same company are traded concurrently and are identical except that one class is not entitled to the next dividend payment. The market value of the dividend can be inferred by comparing the market prices of the two classes of share.

In a rights issue, the new shares are offered to shareholders pro rata to their existing holdings. They are issued 'nil-paid' at the start of the offer period in the form of provisional allotment letters (PALs) which accompany the prospectus. The shares go ex-rights the day after the offer starts, which means that they no longer carry the right to purchase new shares. The nil-paid PALs or rights can be traded during the offer period in the same way as the existing shares are traded. If a shareholder wants to buy some of the shares he has been offered and to sell the rights to the remainder, his PAL can be 'split' accordingly. The closing date of the offer is the last date for acceptance and payment for the new shares, and must be at least three weeks after the announcement date. The day before the close, dealings in rights commence for fully paid settlement. The new shares are identical to the existing shares, unless there is a dividend to which the new shares do not carry entitlement, and the relevant ex-dividend date falls some time after the ex-rights date. If these circumstances apply, both the price of the new shares nil-paid and the price of the new shares fully paid are affected by the absence of entitlement until the next ex-dividend date, and effectively two classes of share are traded. On the next ex-dividend date there ceases to be any distinction between the new and old shares.

Pre-1997 sample. We identified 212 rights issues during the five fiscal years 6 April 1988 to 5 April 1993 in which the new shares were not entitled to the next dividend. There were no material changes in the tax regime during this period. We could not use 127 of the issues because the relevant ex-dividend date preceded the ex-rights date. Of the remainder, we could not find at least one pair of concurrent trades, or ex-dividend prices, for 23 issues.[3] We excluded one issue because the next dividend was only 0.1p and two issues which had dividends less than one penny and dividend yields of less than half of one percent. With such small dividends coupled with small yields, extreme estimates of dividend value are likely to arise as a consequence of measurement errors of small absolute value. Our final sample consists of trades following 59 rights issues.

We use trade-by-trade prices and match the prices as closely as possible by the intraday times of the trades. Prices and times of trades in the existing shares, the new shares nil-paid (rights) and the new shares fully paid were obtained from the Stock Exchange Daily Official List (SEDOL). There is a SEDOL 'book' for every trading day, in which details of all the trades of shares listed on the London Stock Exchange are recorded. The trades are listed by the hour in SEDOL, so we are able to identify when trades took place within one hour of each other. The prices we use are averages of the prices of the trades observed within each hour:

$$\overline{Pold}_t = \frac{1}{n_t}\sum Pold_t \tag{2}$$

$$\overline{Pnil}_t = \frac{1}{n_t}\sum Pnil_t \tag{3}$$

$$\overline{Pnew}_t = \frac{1}{n_t}\sum Pnew_t \tag{4}$$

where $Pold_t$ is the observed price of a trade in the existing (old) shares of a given company at hour t, $Pnil_t$ is the price of the nil-paid shares, $Pnew_t$ is the price of the new shares from the date for fully paid settlement, and n_t is the number of trades in the share during hour t. A price is only included if both classes of share were traded at least once in a given hour; if there was a trade in one class of share but not the other, the price is ignored.

[3] We required the ex-dividend prices to construct a sample matched to the concurrent trades sample, in order to value the dividends using the ex-dividend method.

The resulting sample contains 2,551 pairs of prices following the 59 rights issues. With nil-paid shares, the difference in price between the old and new shares for hour *t* is estimated as:

$$Diff_t = \overline{Pold_t} - (\overline{Pnil_t} + Poffer) \tag{5}$$

where $Diff_t$ is the price difference and *Poffer* is the offer price per share for the new shares. With fully paid shares, the price difference is simply:

$$Diff_t = \overline{Pold_t} - \overline{Pnew_t} \tag{6}$$

Strictly speaking, the present values of the share price and offer price should be used in the above equations, and $Diff_t$ should be compared with the discounted value of the next dividend. However, as the time lags are short, we work with unadjusted offer prices and dividends. Since the offer price would tend to be paid later than the price of the existing shares (though not always, because of the fixed-date settlement periods), the present-value adjustment would probably increase the estimated market value of the dividend. Discounting would definitely reduce the face value of the next dividend. Hence, our DVR estimates would almost certainly be larger were we to make the present-value adjustments. The same comment applies to the results of ex-dividend day studies, none of which, to our knowledge, adjust for the lag between the ex-day and actual receipt of the dividend.

There are two ways to arrive at a sample of paired prices. One way is to treat the 2,551 paired prices as observations, but this sample will not have been selected independently from the population of potential paired prices. Shares that are relatively liquid and trade frequently, and shares for which there is a longer period of time between the ex-rights day and the ex-dividend day, are more heavily weighted. To avoid this problem, we calculate a price difference for each rights issue, and treat this as one observation in our statistical tests. The price difference for a given rights issue is computed as the average of the hourly price differences for the whole of the trading period in the relevant share:

$$Diff = \frac{1}{nhours} \sum Diff_t \tag{7}$$

where *nhours* is the number of hours in which there was at least one trade in each class of

share. With each rights issue treated as an observation, each DVR is given by:

$$DVR = \frac{Diff}{D} \tag{8}$$

With each hourly price difference treated as an observation, each DVR is given by:

$$DVR_t = \frac{Diff_t}{D} \tag{9}$$

Post-1997 sample. In July 1997 pension funds ceased to be able to reclaim ACT from the Inland Revenue. In order to assess the impact of this policy change, we attempted to gather a post-1997 sample. It seems that the practice of issuing new shares with a different dividend entitlement from the old shares has become more unusual in recent years, as have rights issues themselves. We checked the prospectuses of 142 rights issues during 1 July 1998 to 31 March 2004 and only 19 had new shares not entitled to the next dividend, together with an ex-date after the ex-rights date. We could not find concurrent trades, or ex-dividend prices, for five of these issues. Consequently the post-97 sample consists of only 14 issues, but with 1,252 matched pairs of prices.

(ii) Comparison with ex-dividend day evidence

Using the ex-dividend day method we compute the value of dividends for the concurrent trades sample, which allows a direct comparison of the two methods. As the resulting estimates for this matched sample cover only a small number of ex-dividend events, we also report ex-dividend day results for a much larger unmatched ex-dividend sample, of 4,046 dividends during 6 April 1988 to 5 April 1993 and 1,814 dividends during 27 March 1998 to 31 December 1999. Prices used in the ex-dividend analysis were mid-point closing prices extracted from Datastream and Extel.

We argue that the concurrent trades method should provide estimates of the market value of dividends which will be more accurate than those from ex-dividend day studies. The concurrent trade measurements are likely to be less noisy and should also alleviate the biases due to time lags and market microstructure effects discussed in Section 2(i). The estimates are

likely to be less noisy because the concurrent trades method enables the market value of a given dividend to be estimated from repeated observations of time-matched trades of shares with different entitlements to the next dividend. The number of observations can be as large as a few hundred. The ex-dividend method only provides one estimate of market value per dividend. In addition, the ex-dividend studies referred to in Section 2(iii) use market-makers' mid-point prices at the close of the market each day, so the lag between observations of cum-dividend and ex-dividend prices is at least twenty-four hours. Due to infrequent trading, some shares will have a longer gap between cum and ex-dividend prices which reflect actual trades (the proportion is 8.6% in the sample of Bell and Jenkinson, 2002). However, using the concurrent trade method the lag between one price and its pair can be no more than an hour.

We would also expect the concurrent trades method to avoid the potential tick size bias in an ex-day study. This can be seen by considering how a tax-exempt arbitrageur might exploit the difference in price between an old share and a new share not entitled to the next dividend. Suppose the price of the old share is 100p, the tick size is 1p and the next dividend is 2.5p. If the price of the new share is 98p, there is a pure arbitrage gain of 0.5p per share available by buying the old share, selling short the new share, capturing the dividend and closing out the position on the ex-day. On the other hand, if the price of the new share is 97p, a pure arbitrage gain of 0.5p can also be made, by buying the new share and selling short the old share. On the ex-day, both shares become identical, and the arbitrageur receives 3.0p, whatever the share price, which exceeds the cash value of the dividend by 0.5p. A pure arbitrage gain is possible whether the price is 98p or 97p, or generally, whether the market value of the dividend is the cash value rounded down or rounded up to an exact multiple of ticks. Thus, although the presence of discrete price movements will be a source of noise in the inferred market value of a dividend, there is no reason to expect the tick effect to cause bias with the concurrent trades method.

The concurrent trades method also avoids bias due to the fixed-date settlement periods. This could arise in an ex-day study using pre-1994 data because of the preponderance of ex-dividend days on the first Monday of an account. Concurrent trades are spread across the week rather than being clustered on Mondays. In addition, as trades are spread through time rather

than being concentrated on the ex-date and the preceding trading day, systematic bias due to bid-ask spread effects is much less likely. However, the estimates from the concurrent trades method are still subject to noise from random shifts between bid and ask prices.

4. RESULTS

(i) Summary statistics and hypothesis tests

Summary statistics for dividends, yields and DVRs are shown in Table 2, and Table 3 reports the results of tests of whether mean DVRs are equal to 1.00 and of whether mean DVRs for the different samples and methods are equal to each other. We do not report any hypothesis tests using the concurrent data by individual trades, as it is questionable whether the DVRs by individual trades are independent estimates.

Tables 2 and 3 around here

Pre-1997 results. Panel A of Table 2 shows statistics for the pre-97 samples. Taking the concurrent trades sample, the mean DVR for the 59 issues is 1.08 (median 1.16), and the mean DVR for the 2,551 matched trades is 1.25 (median 1.38). However, these sample means are not significantly different from one (Table 3, Panel A.) In contrast, the mean DVR for exactly the same companies and dividend payments but using the ex-dividend method is only 0.43 (median 0.42) and this sample mean is significantly less than one (Table 3. Panel A.)

The difference between the concurrent trades mean DVR by issue and the ex-dividend day matched sample mean is significant at the 5% level using the *t*-test, and at the 1% level using the non-parametric Mann-Whitney test (Table 3, Panel B). If it is accepted that the concurrent trades method provides more precise estimates of DVR, this result suggests that DVRs from ex-dividend day studies have been understated.[4] The mean DVR for the, much

[4] In the matched ex-dividend sample, the ex-dividend day is preceded by a rights issue, and this might have caused the returns from this sample to be atypical in relation to returns around other ex-days. As a check, we calculated raw and abnormal returns for seven days, centred on the ex-day. The abnormal returns are estimated using the market model. The only day on which the average abnormal return is significantly different from zero is the ex-day, for which it is 1.42% (raw) and 1.38% (abnormal). A positive abnormal return is expected on the ex-day,

larger, unmatched ex-dividend sample is 0.95 (0.88), which is at the upper end of the range of estimates in previous UK studies. The unmatched sample mean is significantly below one according to the Mann-Whitney test, but not according to the *t*-test. Similarly, the difference between the concurrent trades mean of 1.08 and the unmatched ex-dividend mean of 0.95 is significant according to the Mann-Whitney test, but not according to the *t*-test.

The mean dividend yield of the unmatched sample is 1.79% (median 1.60%), somewhat below the mean yield of 2.11% (median 1.92%) of the concurrent trades sample. If there is a positive relation between DVR and yield, this could help explain the larger DVR found for the rights sample, though it would still leave unexplained the low DVR for the matched ex-dividend sample. However, we do not find a relation between DVR and yield, as discussed below.

It is also apparent in both panels of Table 2, that the estimates of DVR using the ex-dividend method are much noisier than the concurrent trade estimates. The standard deviation of the DVRs by concurrent trades for 1988-93 is 0.53, compared with a standard deviation of ex-dividend DVRs of 2.07 for the matched sample and 5.51 for the unmatched sample. This supports our prediction that the concurrent trades method should provide more precise estimates of dividend values.

A full list of the concurrent trades sample is provided in the Appendix. It shows, by company, the number of pairs of trades, the mean DVR and the standard error for each issue. The data suggest heterogeneous valuation of dividends across stocks. There is considerable variation across relatively precise DVRs from before and after 1997. For example a dividend of 9.90p for Bass has a DVR of 1.80, based on 494 observations and a standard error of 0.02; a 2.50p dividend for Granada Group has a DVR of 1.10 based on 189 observations with a standard error of 0.05; and a 2.80p dividend for Tootal has a DVR of 0.26 based on 52 observations with a standard error of 0.06.

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given a drop-off ratio less than one. We conclude that there is no sign of unusual returns around the ex-day for the matched sample. The results are available from the authors on request.

Given the relative precision of many estimates, the variation in DVRs is not readily explained away as purely sampling error. We note, however, that some of the variation in DVRs is due to noise, particularly for cases with small dividend yields. Logica, for example, with a DVR of 6.30, has a dividend of 1.90p, but the dividend yield is only 0.098%. With the dividend value being such a small fraction of the share price, the measurement of dividend value is easily confounded by other factors such as bid-ask spread.

Post-1997 results. Panel B of Table 2 reports summary statistics for the post-1997 samples. For the concurrent trades sample, the mean DVR across the 14 issues is 1.61 (median 1.13), and the mean DVR across the 1,252 matched trades is 2.51 (median 1.31). Compared to the pre-1997 concurrent trades results, the means are larger, but the medians are slightly smaller. However, none of these differences is statistically significant (Table 3, Panel C.) The mean DVR using the ex-dividend day matched sample is lower post-1997, at 0.24 (median 1.04), but again the difference is not significant.

Given the elimination of cash refunds of ACT for pension funds, it is surprising that there is no evidence of a fall in DVR post 1997. Clearly the post-97 sample is small, measured by number of issues, and the result could be dismissed as unrepresentative due to the small sample size. On the other hand, the concurrent trades result is based on 1,252 separate observations of pairs of trades. For several shares (6 out of the 14), the DVR per issue (the mean of the pairs of trades for that issue) is based on relatively large samples of 50 or more matched pairs. The DVRs for the majority of shares are estimated with relatively little noise, and the means are more than two standard errors above one for 8 of the 14 observations post 1997.

The mean DVR for the unmatched ex-dividend day sample post 1997 is 0.60 (median 0.86) but it is not significantly different from the mean of the unmatched pre-1997 ex-dividend sample. Thus, the concurrent trades sample, the matched ex-dividend sample and the unmatched ex-dividend sample consistently fail to provide significant evidence of a change in DVRs post 1997.

(ii) Estimates of DVR from regression

The regression approach adopted in some ex-dividend studies regresses the ex-day price drop divided by the share price on the dividend yield (Boyd and Jagannathan, 1994; Bell and Jenkinson, 2002). The slope coefficient of this regression provides an estimate of the marginal DVR. The reason for running the regression in this scaled form is that errors in the ex-day market value of dividends tend to be heteroscedastic, being greater for small dividends, so that taking the raw (unweighted) dividend gives more weight to the values of small dividends. Dividing by the share price alleviates the heteroscedasticity, though it introduces a potential bias by giving more weight to high-yielding shares. It is not clear that dividing through by the share price is required for the concurrent trades values by issue, since these values are estimated with less error. However, we follow the previous literature and regress the scaled price difference by issue, *Diff/Pold*, on the dividend yield, *D/Pold*, where:

$$\frac{Diff}{Pold} = \frac{1}{nhours}\sum \frac{Diff_t}{Pold_t}$$
$$\frac{D}{Pold} = \frac{1}{nhours}\sum \frac{D}{Pold_t} \qquad (10)$$

In addition, we regress the unscaled price difference by issue *Diff* on the dividend *D*.

Table 4 around here

Table 4 reports regression estimates of DVR for pre-1997 data, estimated from concurrent trades by issue and from ex-dividend day price changes. The DVR from concurrent trades is 0.82 if the price difference and dividend are scaled, which is not significantly below 1.00, and 1.47 if they are unscaled, which is significantly above 1.00. The DVRs from the ex-dividend method for the matched sample are 0.38 (scaled) and 0.98 (unscaled). For the unmatched sample, the marginal DVRs are 0.89 (scaled) and 0.75 (unscaled), and both these coefficients are significantly below one. It is noteworthy that the R^2 values of the regressions using concurrent trades data are much higher than they are for the ex-dividend data.

In analysing the residuals from the regressions it became evident that there were some

substantial outliers and departures from normality. Therefore the regression analyses for both concurrent trading data and ex-dividend data were repeated using robust regression.[5] The corresponding DVR estimates using robust regression are larger across the board. So the outlier observations in dividend valuation regressions appear to depress the DVR. For the scaled robust regressions, the DVR estimate using concurrent trades data is 1.30, significantly above 1.00, compared with 0.93 for the matched ex-dividend sample and 0.97 for the unmatched sample, neither of which is significantly different from 1.00. For the unscaled robust regressions, the DVR estimate using concurrent trades data is 1.52, significantly above 1.00, compared with 1.06 for the matched ex-dividend sample and 0.99 for the unmatched sample, neither of which is significantly different from 1.00.

The scaled and unscaled regressions give conflicting results with regard to the intercept. The intercept is expected to be negative if arbitrageurs are the marginal traders. It reflects the impact of transactions costs on the profitability of dividend arbitrage. Alternatively a negative coefficient could be due to the tick size effect. With one exception, the intercepts of the scaled regressions are not significantly different to zero, which is consistent with dividend values at the margin that are set by investors rather than by arbitrageurs. However, with one exception, all but one of the intercepts of the unscaled regressions are significantly negative.

In summary, the regression approach tends to support the earlier results (Tables 2 and 3) that the concurrent trades method produces higher estimates of DVR than the ex-dividend method. The robust regressions also give consistently higher estimates for the DVR. This suggests that outliers consistently cause a downward bias in DVR estimates. The concurrent trades and robust regression results give estimates of the DVR that are either significantly greater than one, or not significantly different from one, whereas the OLS estimates from the unmatched ex-dividend data are significantly less than one.

[5] The purpose of robust regression is to fit a model where the estimates are resistant to the effect of outliers. The type of robust regression we use is known as an M-estimator since it is related to maximum likelihood estimation. The method works by reweighting the observations associated with outliers. The extent of the re-weighting is determined by an influence function. In this study Andrew's sine influence function was used.

(iii) Regression results including post-1997 data

Table 5 presents the results of extending our analysis in Table 4 by adding the post-1997 data. To test whether the post-1997 period was accompanied by a change in dividend values, we incorporate intercept and slope dummies into the regressions. The intercept dummy takes the value zero for the pre-97 period and the value one thereafter. The slope dummy is formed as a multiplicative interaction term between the intercept dummy and the dividend variable, that is dividend yield (scaled regression) or dividend (unscaled regression). The change in the marginal DVR is measured by the coefficient on the slope interaction dummy.

Table 5 around here

The results, both for the concurrent trades samples and the unmatched ex-dividend day samples, provide no consistent evidence of a fall in dividend valuation after July 1997. Across the twelve regressions in Table 5, eight of the slope interaction coefficients are not significantly different from zero, while the other four coefficients are negative and significant. Only one of the intercept dummies is significant and it is positive.

(iv) Relation between DVR and yield

We have suggested that the tick size and bid-ask spread effects are less likely to matter in the concurrent trades method. If so, the evidence from concurrent trades should provide a relatively clear indication of the tax status of the investors or arbitrageurs setting prices at the margin. The Chu and Partington (2002) analysis and consideration of the ownership characteristics of UK equities suggest that tax-privileged institutions acting as investors are likely to determine dividend values in many cases. If so, there should be no relation between the DVR and dividend yield. Alternatively, if the institutions are acting as arbitrageurs rather than investors, there should be a positive relation between DVR and dividend yield, due to the costs of arbitrage. The magnitude of the DVR would depend on these arbitrage costs. The standard tax-clientele hypothesis also predicts a positive relation between DVR and yield, since high yield stocks will be held by low tax investors and vice versa. In addition, a positive

relation between the DVR and dividend yield is predicted by the tick effect, at least in ex-dividend evidence.

Table 6 around here

Table 6 shows the mean DVRs for three samples, partitioned by dividend yield quintiles. The samples are the concurrent trades sample pre-1997 and the unmatched ex-dividend sample pre-1997 and post-1997. It can be seen that there is no monotonic relation between the mean DVR per quintile and the mean yield. We have also run regressions, for each sample, of DVR on dividend yield. In none of the regressions (not reported) are the slope coefficients significantly different from zero, and all have R^2 values of less than 0.02. The absence of a relationship between DVR and dividend yield is as predicted by the Chu-Partington analysis, and is inconsistent with arbitrage trading, the tax-clientele effect, and the tick size effect.

In studying the effect of the 1997 tax change, Bell and Jenkinson (2002) measure the dividend yield on a share using an estimate of the dividend for the full year, rather than using the interim or final dividend which is the dividend used in Table 6 and in other existing studies. They also estimate the DVR per quintile by the scaled regression method, rather than by the mean DVR for the quintile. They do not find a monotonic relation between DVR and yield either, but they argue, nevertheless, that there is evidence for the existence of tax clienteles during their sample period (1995-99). They find that the fall in DVR after 1997 is the second-largest for the highest-yielding quintile, which, on the tax-clientele view, consists of the shares which are most likely to be owned by pension funds. We do not find this result in our unmatched ex-dividend samples. The lower-yielding quintiles have much larger falls in mean DVR than does the highest-yielding quintile. We infer that the ex-dividend evidence regarding the impact of the tax change in 1997 on dividend valuation is sensitive to the method of estimating a share's dividend yield.

5. CONCLUSION

Our comparison of the concurrent trades and ex-dividend methods of estimating dividend values indicates that they give significantly different results. The ex-dividend estimates are much noisier than the concurrent trades estimates, and they usually give lower values for the DVR, unless robust regression is used. Existing studies report mean DVRs which are significantly less than one for samples from before 1997. These findings have been somewhat puzzling, in the light of the ability of tax-exempt investors to reclaim advance corporation tax from 1973. With one exception, estimates of the DVR from the concurrent trades method exceed one and significantly so for most of the regression estimates. In contrast, with the exception of some robust regression results, the estimates of DVR from the ex-dividend method are less than one. The DVR is particularly low in the ex-dividend sample which matches the sample used in the concurrent trades method.

The finding of higher dividend values from the concurrent trades method suggests that estimates of the market value of dividends from ex-dividend day studies are biased downwards. The time gap of one day between observation of cum-dividend and ex-dividend prices leads to substantial noise in using the ex-dividend price drop as a measure of dividends. Noise and associated outliers would not be expected to lead to downward bias in the measurement of dividend values; however the results of the robust regression suggest that such bias is indeed the consequence of ex-dividend outliers. This is consistent with Davidson and Mallin (1989) who also obtain higher estimates of the DVR using the robust technique of least absolute deviation. We argue that most of the biases are alleviated by using the concurrent trades method. On the basis of our results we also suggest that researchers using ex-dividend data consider analysis of those data with robust regression.

The evidence presented here, to some extent, supports the view that the market value of dividends is determined by tax-privileged institutions, which could reclaim some or all the ACT paid by companies. This explains the DVRs of more than one before 1997. However, we find little evidence of a significant drop in DVRs post 1997, for either the concurrent trades, or ex-dividend samples. The post-1997 concurrent trades sample only consists of 14 issues, but it has 1,252 observations of dividend values from pairs of trades. Because of the large

numbers of pairs of trades for many of the issues, and the low level of noise in the observations for a given share, the mean of the DVRs for some issues is estimated with low standard error. There are 8 issues after 1997 with a mean DVR which is more than two standard errors above 1.

The ability to estimate the DVR from many observations per ex-dividend event is an advantage of the concurrent trades method. It is evident from examination of the individual issues that there is heterogeneity in DVR estimates across ex-dividend events both before and after 1997 (see Appendix). The heterogeneity of estimates for DVRs that have relatively low standard errors, implies that there is heterogeneity in the type of marginal trader who determines the market value of a given dividend for a given share. The type of trader could vary both by tax status, and by whether the trader is a long term investor or an arbitrageur.

Unlike Bell and Jenkinson (2002), we find no evidence that tax clienteles affect dividend values. In both the concurrent trades and the ex-dividend samples our tests find no relation between DVRs and dividend yields. Also, we do not find that post-1997 the DVR falls most for the highest-yielding shares, although we do not measure yield in exactly the same way as Bell and Jenkinson. In addition, our evidence does not provide clear support for the hypotheses that dividend values are predominantly set by arbitrageurs, or are affected by the tick size. Our evidence suggests that the process by which equilibrium market values for dividends are determined is indeed ‘messy’, as implied by the analyses of Boyd and Jagannathan (1994, p. 723) and Chu and Partington (2002). There appears to be heterogeneity across dividend values in the identity of the marginal trader, and the heterogeneity does not seem to have a simple explanation. However, the bulk of our evidence supports the view that, on average, the market value of dividends was equal to, or greater than, the face value, both before and after 1997.

APPENDIX: CONCURRENT TRADES ESTIMATES OF DVR BY ISSUE

Company name at time of issue	Ex-rights date	Market capitalisation (£m)*	Net dividend	DVR	Pairs of prices	DVR standard error
Pre-1997 sample						
AIM Group	01/08/89	46.4	6.60	0.81	7	0.42
Airbreak Leisure Group	16/01/92	14.2	1.31	0.42	16	0.16
Allied Leisure	23/02/93	21.8	1.00	0.00	3	0.00
Amec	22/04/91	354.2	6.25	1.72	34	0.05
Anglo United	11/06/91	94.5	1.40	0.68	11	0.14
Argyll Group	21/05/91	2,914.3	5.85	1.50	170	0.01
Asda Group	01/02/93	1,826.0	0.50	1.39	90	0.08
Attwoods	28/03/91	323.6	3.25	1.14	12	0.11
Baird	01/05/91	240.2	5.35	1.06	18	0.08
Barry Wehmiller Intnl.	09/10/91	68.2	4.30	0.37	11	0.10
Bass	28/03/91	3,557.9	9.90	1.80	494	0.02
Beales Hunter	16/01/92	19.9	2.30	0.98	4	0.45
Bespak	25/06/91	56.5	5.00	1.40	5	0.19
Bowater	26/03/92	1,181.9	12.50	0.88	138	0.05
British Polythene Industries	18/09/91	63.5	3.00	1.19	30	0.18
British Vita	05/03/92	465.7	3.60	1.22	70	0.06
Bullers	14/02/90	17.0	1.50	0.33	26	0.21
Capital & Counties	27/08/91	360.0	5.00	0.81	8	0.15
Cater Allen Holdings	18/06/90	81.4	19.13	1.41	9	0.16
Concentric	17/05/89	57.6	3.54	0.51	13	0.19
Cookson Group	08/03/93	952.1	3.00	1.61	111	0.04
Dart Group	01/07/91	15.6	1.80	0.00	1	
ECC Group	26/02/92	1,101.1	13.40	1.33	247	0.02
Ellis & Everard	17/05/90	114.8	4.80	1.87	33	0.17
EMAP	10/06/92	395.2	5.50	1.55	23	0.11
Epwin Group	25/03/92	28.7	4.50	1.11	1	
First Leisure Corporation	19/07/90	297.0	1.55	0.79	59	0.18
Gardiner Group	21/06/91	54.9	0.47	0.38	6	0.71
Granada Group	04/06/91	626.0	2.50	1.10	189	0.05
Hampden Homecare	20/03/89	9.0	1.50	1.33	1	
Heywood Williams Group	07/03/91	171.4	8.00	1.32	16	0.07
Hillsdown Holdings	27/09/91	1,398.4	2.20	–0.21	109	0.11
Howden Group	01/03/93	137.2	0.75	2.73	61	0.26
J Bibby & Sons	10/05/91	184.5	2.85	0.91	14	0.21
Ladbroke Group	17/09/91	2,366.6	4.92	1.28	287	0.03
Laird Group	15/04/92	96.8	6.20	1.25	39	0.05
Lamont Holdings	12/05/92	83.9	8.50	1.46	24	0.08
Marshalls	10/06/92	90.2	3.75	1.03	8	0.23
Merchant Retail Group	07/06/91	27.2	1.30	1.01	29	0.10

Company name at time of issue	Ex-rights date	Market capitalisation (£m)*	Net dividend	DVR	Pairs of prices	DVR standard error
Morgan Crucible Co	17/04/91	457.6	6.75	1.32	66	0.06
Northern Foods	09/12/91	1,144.3	6.85	1.58	54	0.04
Ocean Group	11/04/91	447.8	9.53	1.54	20	0.06
Pendragon	23/03/93	87.1	4.40	1.55	12	0.11
Pentos	17/08/90	109.6	0.60	1.11	7	1.31
Pepe	11/07/89	84.6	4.00	0.74	4	0.51
Porvair	20/02/92	17.3	2.20	0.91	3	0.00
PWS Holdings	08/05/90	16.1	1.30	0.42	12	0.30
Redland	26/03/91	1,779.7	16.75	1.52	244	0.01
Resort Hotels	01/05/92	55.7	2.25	1.20	103	0.06
Sage Group	28/03/91	43.3	2.70	1.48	13	0.30
Scapa Group	23/05/91	283.7	3.76	0.74	18	0.10
Senior Engineering Group	17/02/92	136.3	1.95	1.38	53	0.09
Simon Engineering	29/03/90	238.0	11.00	1.48	52	0.03
Sims Food Group	11/11/91	84.0	3.00	1.20	7	0.45
Tootal	11/04/88	265.8	2.80	0.26	52	0.06
Westbury	16/05/88	88.8	3.75	1.12	11	0.20
Whitecroft	24/06/91	61.2	5.40	0.22	8	0.08
Wm Low	16/11/90	139.5	5.25	1.08	8	0.08
WYKO Group	17/07/89	17.8	2.00	1.17	3	0.44
Post-1997 sample						
Albermarle & Bond	18/09/98	25.8	0.75	1.77	5	0.77
Davis	09/04/02	646.2	11.25	1.50	39	0.06
Dyson	08/04/02	37.4	4.65	1.14	107	0.03
Enterprise	24/05/02	785.4	4.70	1.71	21	0.14
Eurodis Electron	04/09/00	110.5	2.50	1.06	33	0.09
Highbury House Comms	02/02/00	88.5	0.30	2.90	330	0.15
Imperial Tobacco	09/04/02	4,743.6	12.00	1.12	206	0.01
LA Fitness	27/09/00	109.2	0.33	–0.74	14	2.45
Lavendon	14/03/01	161.7	4.35	1.10	19	0.01
Logica	04/10/00	9,386.7	1.90	6.30	206	0.70
Marylebone Warwick B. 1	26/11/99	80.9	1.40	2.94	83	0.20
Marylebone Warwick B. 2	03/11/00	184.9	1.40	0.81	75	0.20
Pearson	28/07/00	12,601.9	9.20	0.17	18	0.13
Pressac	22/07/98	136.5	3.52	0.17	96	0.98

* As at the day before the announcement of the rights issues.

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Table 1

Value after tax of dividends during period 6 April 1988 to 5 April 1993

Investor	Value after tax of £1 of net dividends: Ignoring CGT[1]	Value after tax of £1 of net dividends: Assuming CGT is paid at the maximum rate[2]
Higher rate individual	£0.80	£1.33
Basic rate individual	£1.00	£1.33
Corporate shareholder	£1.00	£1.54
Life assurance fund	£1.00 to £1.33	£1.67 to £2.22
Pension fund, charity, other tax-exempt investor	£1.33	£1.33
Foreign investing institution	£1.00 to £1.07	£1.00 to £1.07

Notes

1. Value after tax ignoring CGT is $(1 - T_I)/(1 - T_{ACT})$, where T_I is the income tax rate of the investor and T_{ACT} is the advance corporation tax rate, which was 25% during 1988-93. Higher rate T_I was 40%, basic rate T_I was 20%. Dividends received by companies were not taxed twice: UK resident companies could use their tax credits to eliminate their own liability to ACT. Life funds could reclaim some or all of ACT, the amount depending on fund-specific circumstances. Exempt investors could reclaim all of ACT. Some foreign investors could reclaim some of ACT (the £1.07 figure is from Bell and Jenkinson, 2002).

2. Value after tax allowing for CGT is $(1 - T_I)/(1 - T_{ACT})(1 - T_G)$, where T_G is the maximum CGT rate for the relevant category of investor, ignoring provisions which reduce CGT payable. $T_I = T_G$ for individuals from 1988. Companies pay corporation tax on chargeable gains; the full rate of corporation tax was 35% in 1988-90, 34% in 1990-91 and 33% in 1991-93. Life funds pay CGT on chargeable gains net of any expenses which can be set against chargeable gains. The CGT rate for life funds was 30% in 1988-89 and 40% in 1989-93. Tax-exempt investors paid no CGT and we assume that foreign investors paid no UK CGT.

Sources: Inland Revenue Statistics; MacLeod and Levitt (1999).

Table 2
Descriptive statistics for concurrent trades and ex-dividend data

Estimates of the dividend valuation ratio (DVR) are given by *Diff/D* for concurrent trades by issue, $Diff_t/D$ for concurrent trades by trade, and $(P_{cum} - P_{ex})/D$ for the ex-dividend method. *D* is the dividend value net of advance corporation tax; $Diff_t$ is the difference in value between the old and the new shares following a rights issue for hour *t*; *Diff* is the mean of $Diff_t$ for a given issue; P_{cum} is the price of the old share at the close of the day before the ex-dividend day; P_{ex} is the price at the close of the ex-day. Dividend yield is calculated as at the day before the ex-day.

	Mean	*Median*	*Std dev*	*Min*	*Max*
Panel A: 1988-93					
Concurrent trades and matched ex-dividend sample					
Dividend (pence)	4.66	3.75	3.86	0.47	19.13
Dividend yield (%)	2.11	1.92	1.04	0.59	5.17
Concurrent trades by issue (N = 59)					
DVR	1.08	1.16	0.53	–0.19	2.72
Concurrent trades by trade (N = 2551)					
DVR	1.25	1.38	0.85	–4.51	10.67
Ex-dividend method (N = 59)					
DVR	0.43	0.42	2.07	–3.64	12.50
Unmatched ex-dividend sample *(N =4046)*					
Dividend (pence)	5.14	3.80	5.33	0.05	98.00
Dividend yield (%)	1.79	1.60	0.99	0.03	7.55
DVR	0.91	0.88	5.51	–50.00	308.82

Table 2 cont.

	Mean	*Median*	*Std dev*	*Min*	*Max*
Panel B: 1998-2004					
Concurrent trades and matched ex-dividend sample					
Dividend (pence)	4.16	3.01	3.94	0.30	12.00
Dividend yield (%)	1.05	0.90	0.75	0.12	2.55
Concurrent trade by issue (N = 14)					
DVR	1.61	1.13	1.65	-0.74	6.30
Concurrent trade by trade (N = 1252)					
DVR	2.51	1.31	5.00	–33.26	58.26
Ex-dividend method (N = 14)					
DVR	0.24	1.04	6.68	–11.05	14.64
Unmatched ex-dividend sample *(N = 1814)*					
Dividend (pence)	5.48	4.00	5.45	0.01	71.00
Dividend yield (%)	1.57	1.30	1.35	0.05	36.59
DVR	0.60	0.86	6.26	–69.74	113.70

Table 3
Hypothesis tests comparing the DVR for the concurrent trades and ex-dividend methods

Null Hypothesis			
Panel A	***t-statistic***	***Probability***	***Probability (Wilcoxon rank sum)***
1988-93			
DVR (concurrent trades) = 1	1.17	0.25	0.16
DVR (matched ex-div) = 1	–2.12	0.04	<0.01
DVR (unmatched ex-div) = 1	–1.04	0.30	<0.01
1997-2004			
DVR (concurrent trades) = 1	1.39	0.19	0.21
DVR (matched ex-div) = 1	–0.43	0.68	1.00
DVR (unmatched ex-div) = 1	–2.70	<0.01	<0.01
Panel B			***Probability (Mann Whitney)***
1988-1993			
DVR (concurrent trades) = DVR (matched ex-div)	2.35	0.02	<0.01
DVR (concurrent trades) = DVR (unmatched ex-div)	1.54	0.12	<0.01
DVR (matched ex-div) = DVR (unmatched ex-div)	1.70	0.09	<0.01
1997-2004			
DVR (concurrent trades) = DVR (matched ex-div)	0.75	0.47	0.51
DVR (concurrent trades) = DVR (unmatched ex-div)	2.17	0.05	0.06
DVR (matched ex-div) = DVR (unmatched ex-div)	–0.20	0.84	0.76
Panel C			
1988-2004			
DVR pre-97 = DVR post-97 (concurrent trades)	1.19	0.26	0.38
DVR pre-97 = DVR post-97 (matched ex-div)	–0.11	0.92	0.28
DVR pre-97 = DVR post-97 (unmatched ex-div)	1.80	0.07	0.79

Note
Hypothesis tests involving concurrent trades are all based on data by issue. Data by individual trades is not used as it is debateable whether the DVR observations by individual concurrent trades are independent.

Table 4
Estimates of DVR from regression analysis for 1988-93

The first six regressions are scaled regressions: $\mu(Diff/Pold)_i = \alpha + \beta\mu(D/Pold)_i + e_i$ and $(P_{cum,i} - P_{ex,i})/P_{cum,i} = \alpha + \beta D_i/P_{cum,i} + e_i$, where *i* labels a dividend event, and $\mu(Diff/Pold)_i$ and $\mu(D/Pold)_i$ are the mean values of $Diff_t/Pold_t$ and $D/Pold_t$ for event *i*. The second six regressions are unscaled: $Diff_i = \alpha + \beta D_i + e_i$ and $P_{cum,i} - P_{ex,i} = \alpha + \beta D_i + e_i$. The marginal DVR estimate is the coefficient on dividend yield (scaled) or dividend (unscaled). Standard errors are given in parentheses below the coefficients. For the intercept, * (**) indicates coefficients significantly different from *zero* at the 5% (1%) level. For the slope, @ (@@) indicates coefficients significantly different from *one* at the 5% (1%) level. All slope coefficients are significantly different from zero (at the 5% level or better) with the exception of the coefficients shown in italics. Coefficients reported in the table as significant, but shown as zero value, do have non-zero values but rounding to two decimal places reduces them to zero.

Dependent variable	$Diff_i/Pold_i$		$(P_{cum,i} - P_{ex,i})/P_{cum,i}$		$(P_{cum,i} - P_{ex,i})/P_{cum,i}$		$Diff_i$		$P_{cum,i} - P_{ex,i}$		$P_{cum,i} - P_{ex,i}$	
	Concurrent trades data		Matched ex-dividend data		Unmatched ex-dividend data		Concurrent trades data		Matched ex-dividend data		Unmatched ex-dividend data	
Regression	OLS	Robust	OLS	Robust	OLS	Robust	OLS	Robust	OLS	Robust	OLS	Robust
Intercept	0.00	–0.00	0.00	–0.00	–0.00	–0.00**	–1.22**	–1.17**	–2.14**	–2.47**	0.42**	-0.41**
	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.38)	(0.25)	(0.98)	(0.76)	(0.16)	(0.05)
Slope for dividend yield	0.82	1.30@@	*0.38*	0.93	0.89@@	0.97						
	(0.15)	(0.14)	(0.35)	(0.30)	(0.03)	(0.02)						
Slope for dividend							1.47@@	1.52@@	0.98	1.19	0.75@@	0.99
							(0.06)	(0.04)	(0.16)	(0.14)	(0.02)	(0.01)
R^2	0.33	0.67	0.02	0.14	0.16	0.48	0.91	0.96	0.39	0.58	0.22	0.70

Table 5
Change in DVR after 1997

The regressions of Table 4 have been extended by including data for the post-97 samples and adding an intercept dummy and a slope interaction dummy. For example, the unscaled concurrent trades regression is $Diff_i = \alpha + \beta_1 D_i + \beta_2 \delta_i + \beta_3 \delta_i D_i + e_i$; δ_i takes the values of 0 for pre-97 data and 1 for post-97 data. The change in DVR post 97 is measured by the coefficient for the slope interaction dummy. For the intercept, intercept dummy, and slope interaction, * (**) indicates coefficients significantly different from zero at the 5% (1%) level. For the slope on dividend yield and dividends, @ (@@) indicates coefficients significantly different from one at the 5% (1%) level. All slope coefficients on dividend yield and dividends are significantly different from zero (at the 5% level or better) with the exception of the coefficient shown in italics.

Dependent variable	$Diff_i/Pold_i$		$(P_{cum,i} - P_{ex,i})/P_{cum,i}$		$(P_{cum,i} - P_{ex,i})/P_{cum,i}$		$Diff_i$		$P_{cum,i} - P_{ex,i}$		$P_{cum,i} - P_{ex,i}$	
	Concurrent trades data		Matched ex-dividend data		Unmatched ex-dividend data		Concurrent trades data		Matched ex-dividend data		Unmatched ex-dividend data	
Regression	OLS	Robust	OLS	Robust	OLS	Robust	OLS	Robust	OLS	Robust	OLS	Robust
Intercept	0.00	–0.00	–0.00	–0.00	–0.00	–0.00**	–1.22**	–1.18**	–2.14	–2.42**	0.42*	–0.41**
	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.49)	(0.06)	(2.69)	(0.75)	(0.21)	(0.06)
Slope for Dividend yield	0.82	1.30@@	*0.38*	1.18	0.89@@	0.97						
	(0.15)	(0.11)	(0.36)	(0.29)	(0.03)	(0.02)						
Slope for Dividend							1.47@@	1.52@@	0.98	1.17	0.75@@	0.99
							(0.08)	(0.04)	(0.45)	(0.14)	(0.03)	(0.01)
Intercept dummy	–0.01	0.00	–0.01	–0.01	–0.00	0.00	2.72*	1.20	4.14	2.83	–0.66	0.05
	(0.01)	(0.00)	(0.02)	(0.01)	(0.00)	(0.00)	(1.06)	(0.56)	(5.86)	(2.25)	(0.42)	(0.11)
Slope interaction: dummy × div yield	0.33	–0.14	2.00	1.72	0.04	–0.06*						
	(0.45)	(0.29)	(1.17)	(0.87)	(0.05)	(0.03)						
Slope interaction: dummy × dividend							–0.55**	–0.28*	–2.13*	–0.22	0.05	–0.01
							(0.19)	(0.10)	(1.02)	(0.37)	(0.05)	(0.02)
R^2	0.41	0.70	0.04	0.27	0.18	0.49	0.83	0.95	0.07	0.53	0.13	0.71

Table 6
Relation between DVR and dividend yield

Yield quintile	1	2	3	4	5
Concurrent trades: 1988-93					
Mean yield	0.96%	1.57%	2.02%	2.65%	3.59%
Mean DVR	1.07	1.10	1.06	1.10	1.03
Median DVR	1.07	1.10	1.21	1.23	1.14
Number of observations	12	12	12	12	11
Unmatched ex-dividend: 1988-93					
Mean yield	0.65%	1.17%	1.61%	2.18%	3.32%
Mean DVR	1.36	0.72	0.79	0.79	0.89
Median DVR	0.79	0.87	0.90	0.86	0.93
Number of observations	809	809	809	809	810
Unmatched ex-dividend: 1998-99					
Mean yield	0.41%	0.89%	1.32%	1.90%	1.93%
Mean DVR	0.47	0.55	0.91	0.86	0.82
Median DVR	1.06	0.83	0.92	0.84	0.88
Number of observations	363	363	363	363	362